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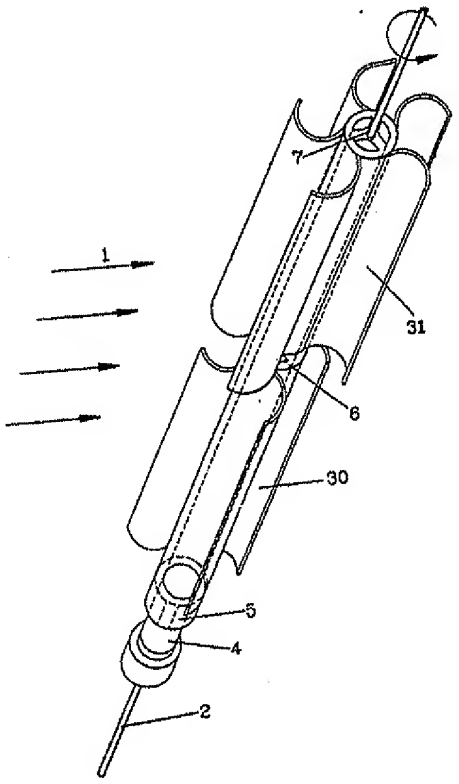
(54) Title: TURBINE DEVICE

(57) Abstract

Turbine assembly comprising at least one rotor provided with vanes that transform the rectilinear motion of a flowing medium into rotational motion of said rotor in which assembly a number of rotors (3A, 3B..., 3N) are arranged so that these rotors revolve around a stay device (2) forming rotation axis (2A, 2B..., 2N) for in series arranged rotors (3A, 3B..., 3N) along said stay device when subjected to a perpendicular or near perpendicular flow of a medium (1) whereby said rotation axes (2A, 2B..., 2N) being formed by a wire or line having low bending resistance where said rotors (3A, 3B..., 3N) interact by means of a coupling device (6).



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TURBINE DEVICE

The present invention refers to a device for the extraction/transformation of energy from a medium in rectilinear motion such as an airstream or water current, comprising one or more rotors working together around a slender stay such as a backstay wire in the rigg of a yacht.

Background of the invention

Larger yachts, say over 6 m, have an increasing need for onboard power supply especially since the use of television sets, microwave ovens, refrigerators etc is becoming common. The use of electronic and electrical equipment has increased the last few years in fishfarming in the sea and in lakes also in cases where the farms are located in inaccessible areas at sea or in a remote forest lake. Electronic surveillance calls for electric power and is in increasing demand especially in this area of business. Other areas with the same need for power supply are for example electronic underwater equipment such as navigation buoys, a mountain based signalling apparatus, irregation plants in less developed countries and so on.

Almost exclusively some type of a battery, often rechargable, will be used in these applications as a prime power source. Yachts for example use a lead battery that is recharged by a generator driven by an onboard combustion engine. This method of recharging is inconvenient in close harbors since adjacent boats and yachts suffer from the engine noise and exhaust in addition to oilspill on the water. The fuel consumption will be high and the engine will show excessive wear under these circumstances as it is operating at adverse speed and power.

Traditional Windgenerators of the propeller type turbine are common amongst long range cruising yachts but need a large

area to fully weather vane and a very solid and stable mounting bracket, has a high centre of gravity in addition to its dependence on the prevailing direction of the wind for its output. Furthermore, fast turning turbine blades constitute a safety risk for people in its proximity. The blades also emit a strong hizzing or clattering noise that may be disturbing. Racing yachts also have a need for recharging the battery but existing so called windgenerators are considered to be too heavy, difficult to place, unsafe and will inflict on the dynamics of the yacht.

Objects and most important features of the invention

The objects of the present invention is to provide a turbine device of said type, which is simple, easy to place with a low centre of gravity in addition to requiring a minimum of space, that works independent of wind direction, is relatively safe, utilises a stay, slender mast or other non rigid stay device for its centre of rotation, symmetry axis, fixation and orientation in a flowing media with its main direction of flow perpendicular to such a stay device.

Description of the drawings

The invention will hereinafter be described in some embodiments with reference to the drawings in which

Fig. 1 shows a three-dimensional view of a first embodiment of the invention where the lowermost rotor section comprises en electric generator;

Fig. 2 shows a yacht with a backstay to which a turbine, according to the invention, is attached and where said turbine drives an electric generator that charges batteries onboard the yacht;

Fig. 3 shows a stay device consisting of lattice structures supported by wire stays to which turbines are attached that drive for example waterpumps and/or generators;

Fig. 4 shows a slender self supporting mast with a turbine that drives a generator;

Fig. 5 shows an instrumented subsurface buoy moored with wires to the sea bed, to which wires turbines are attached for recharging batteries in the buoy;

Fig. 6 shows schematically, through a section in the upper rotor, how several rotors are linked together by a coupling device, of known type, that allowes for misalignment between two adjacent rotors while these rotors rotate around the stay device. This figure also shows how these rotors can be held in place with sperical ball bearings and stopper rings.

Fig. 7 shows an elevated partly sectioned view of a second embodiment of the invention in which a rotor constitutes a part of the stay.

Fig. 8 shows a sectional view of an air brake device in the rotor according to Fig. 7;

Fig. 9 shows a sectional view of a closed center rotor vane configuration in the rotor according to Fig. 7;

Fig. 10 shows a sectional view of an open center rotor vane configuration in the rotor according to Fig. 7;

Fig. 11 shows an elevated partly sectioned view of a third embodiment of the invention in which the shaft of the rotor constitutes a part of the stay having higher bending resistance than the stay;

Fig. 12 shows a sectional view of a closed center rotor vane configuration in the rotor according to Fig. 11;

Fig. 13 shows a sectional view of a ducted center rotor vane

configuration in the rotor according to Fig. 11;

Fig. 14 shows a three-dimensional view of an alternative rotor vane configuration applicable on rotors according to Fig. 1 and Fig. 11.

Description of the embodiments

The turbine device according to the invention comprises an assembly 3 of rotors 3A, 3B ...3N where the letters A - N designate separate rotors (Fig:s 1, 2, 3, 4, 5, 6) with vanes that rotate around a stay device 2 when it is subjected to a flow of a medium 1 (Fig:s 1, 2, 3, 4, 5) perpendicular or near perpendicular to said rotor.
The assembly of rotors 3A,3B,..3N are arranged so that every rotor rotates around its separate movable axis 2A,2B...2N, see Fig. 6.
A stationary generator part 4 (Fig.1), fixed to said stay device, and a generator part 5 which is integrated to the rotor 3A (Fig. 1) generates electric power to a load when the rotor rotates. A bracket 8 (Fig. 4) holds the stay device 2 firmly to the ground.

With reference to Fig. 1 a first embodiment of the invention is shown with two rotors 3A and 3B with a number of 5 vanes designated 300 -304 and 310-314 respectively, through which a stay device 2 in the shape of a steel wire runs. The two rotors 3A and 3B are interconnected by means of a coupling device 6 shown in more detail in Fig. 6, that take up any misalignment between the rotors 3A and 3B so that these rotors can revolve around the wire in Fig. 1 when subjected to for example a wind as shown in Fig. 2 where the assembly 3 of rotors are attached to a backstay of a yacht.

In order to transform the momentum of the rotors 3A and 3B into for instance electric power, a generator can be incorporated in the rotor 3A as shown in Fig. 1, 7 and 11. The generator itself is preferably a permanent magnet

exitation syncronous machine with the permanent magnetizing poles 55 located in the integrated generator rotor part 5. The stationary part or the stator 4 of the generator fits with an air-gap 54 into the integrated generator part 5 and consists of a magnetic flux return path core 42 consisting of eg. laminated iron and coaxially mounted single- or multiphase windings 41.

An energy transformer such as a water pump, generator or hydraulic pump can of course be driven by means of a common belt or chain transmission or by means of gears instead of being fully integrated to any one rotor 3A - 3N.

With reference to Fig. 7 a second embodiment of the invention is described in which a rotor constitutes a part of the stay.
The turbine 3D is provided with upper and lower shafts 35 and 36 respectively on which shafts are mounted ball bearings able to withstand axial and radial loads. The retainer 51 for the bearing 38 is fitted to the upper stay mounting 46 by means of a threading joint. In a similar way the retainer 43 is fitted to the lower stay mounting 45.

With reference to Fig. 8 a sectional view shows an air brake consisting of a strip of metal sheet 50 covering the perifery of the cylindric body 49. When the speed of the turbine 3D increases centrifugal forces pull out the loose end of the strip which increases the drag torque on the rotor counterbalancing the torque generated by the wind stream.
According to Fig:s 9 and 10 the rotor 3A can be equipped with either the closed vane configuration 300 - 303 (4 vanes) or the open center vane configuration 310-317 (8 vanes) which can be extruded from eg. aluminium.

With reference to Fig. 11 in third embodiment of the invention the shaft 2A of the rotor 3A is solid rod, tubular

bar or a prestressed wire which extends through the turbine 3A and mounted in bearings 37 and 38 fitted in lower and upper housings 55 and 56 respectively.
The top of the turbine is covered by a cap 60.

According to Fig. 12 and Fig. 13 the turbine can be equipped with alternate vane configurations as in Fig. 7.
It can be observed that the center tube 39 of the turbine according to Fig. 11 creates a ducted air stream for the vanes 330 - 337 in the vane configuration of Fig. 13 which reduces drag and increases lift forces on the vanes which is favourable with respect to the wind energy conversion efficiency.

Several complete turbine assemblies which each contain a rotor 3A, shaft 2A and generator 4 can be joined together in series to constitute a part of a stay device where each shaft or tubine takes the load of the stay. The generator of each turbine assembly can be connected either in series or in parallel to a common load.

With reference to Fig. 14 the rotor 3A can be equipped with swinging cloth covered vanes 340 - 342 which operate almost entirely with drag forces. Due to the drag operation mode the starting torque is high giving good running characteristics at low wind velocities and a reduced tendency to overspeed at high wind velocities.

Although the above specification has described turbines designed for and applied mainly to a wind stream, the rotor assembly according to the present invention with minor design modifications can be applied in other flowing media such as water.

CLAIMS

1. Turbine assembly comprising at least one rotor provided with vanes that transform the rectilinear motion of a flowing medium into rotational motion of said rotor c h a r a c t e r i z e d i n that a number of rotors (3A,3B..3N) with vanes are arranged so that these rotors revolve around a stay device (2) forming rotation axis (2A,2B..2N) for in series arranged rotors (3A,3B..3N) along said stay device when subjected to a perpendicular or near perpendicular flow of a medium (1).

2. Assembly according to claim 1 c h a r a c t e r i z e d i n that said rotation axes (2A,2B..2N) are formed by a wire or line having low bending resistance where said rotors (3A,3B..3N) interact by means of a coupling device (6).

3. Assembly according to claim 1 c h a r a c t e r i z e d i n that at least one rotational axis (2C) for a rotor (3C) is formed by a part of said stay device having high bending resistance said part being a solid rod or a tube.

4. Assembly according to claim 3 c h a r a c t e r i z e d i n that a rotor (3D) is integrated in the stay device such that it can rotate between two holding points constituted by stay brackets (45,46) and mounted in bearings in points (37,38) respectively taking the full tension of the stay device (2).

5. Assembly according to claims 1-4 c h a r a c t e r i z e d i n that at least one rotor (3A) is provided with an integrated generator part (5) containing permanent magnets (55) which by way of an air gap excites a stationary generator part (4)

comprising windings (41) coaxially arranged on a core (42) of ferro laminate which is attached to said stay device (2) alternatively to said stay bracket (45).

FIG. 1

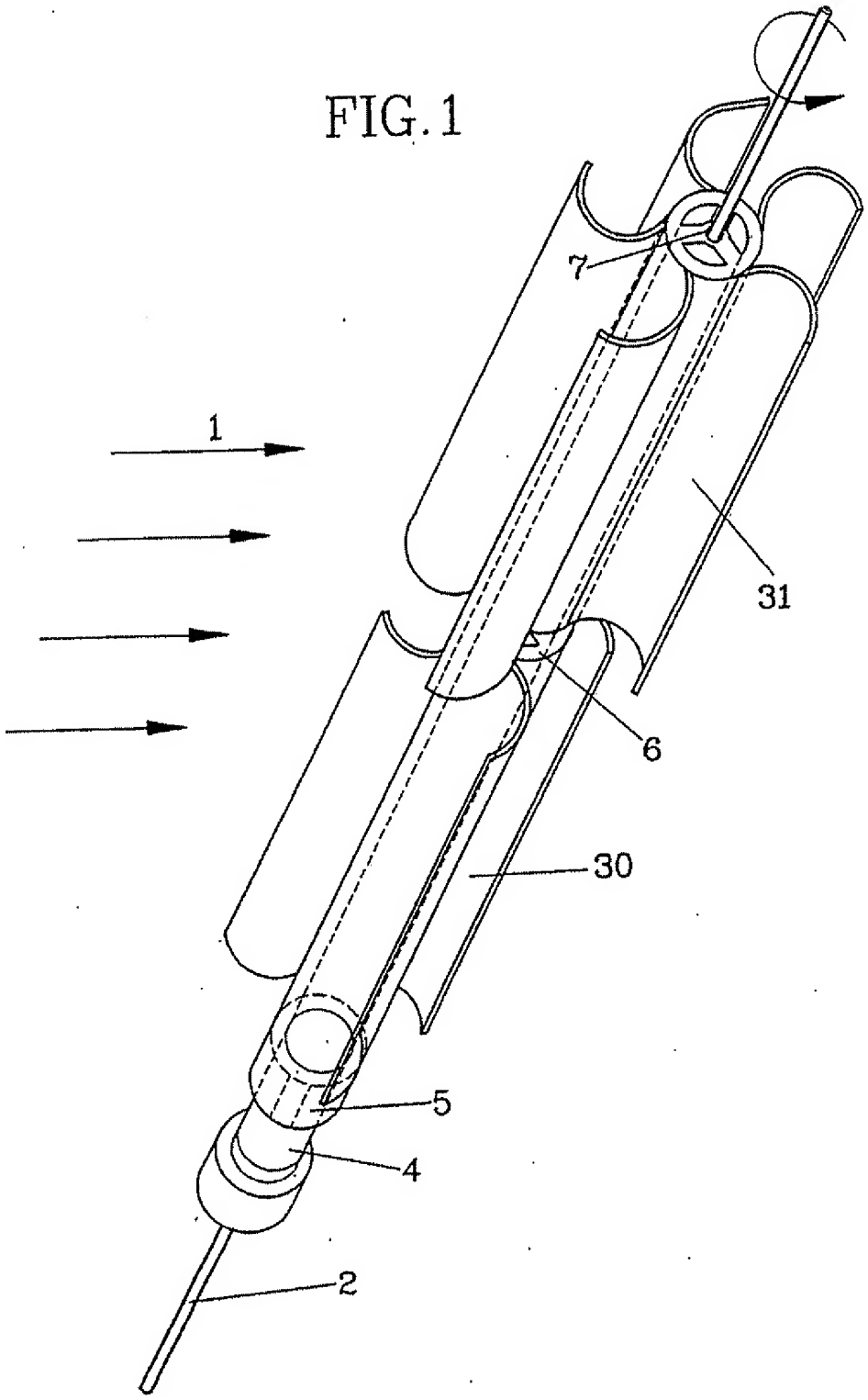


FIG. 2

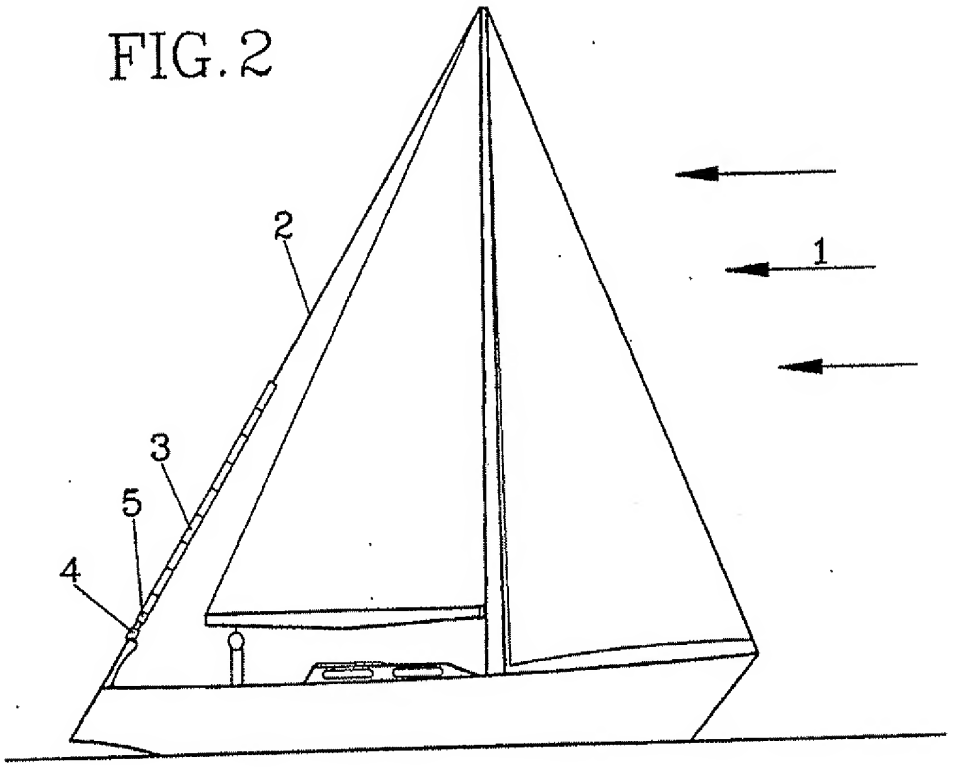


FIG. 3

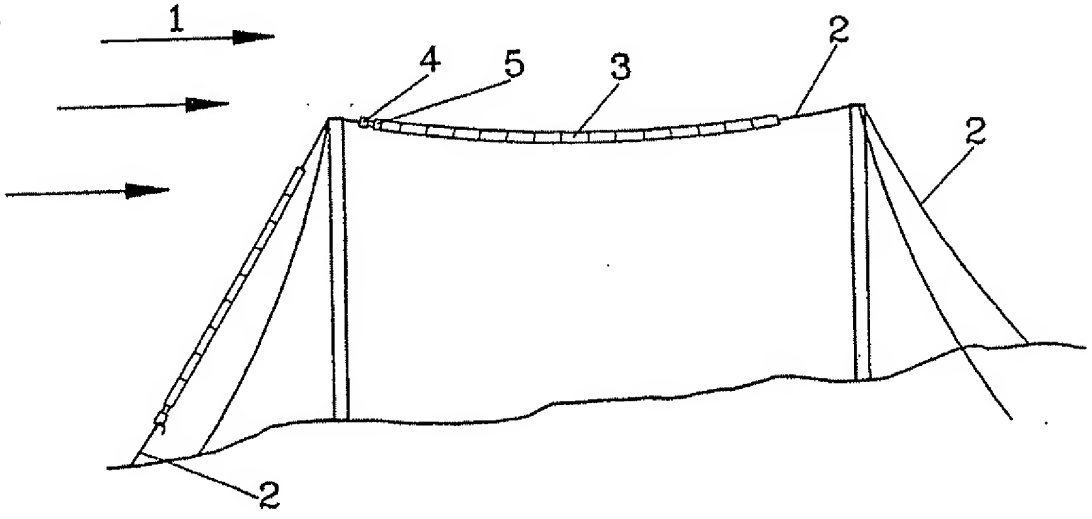


FIG. 4

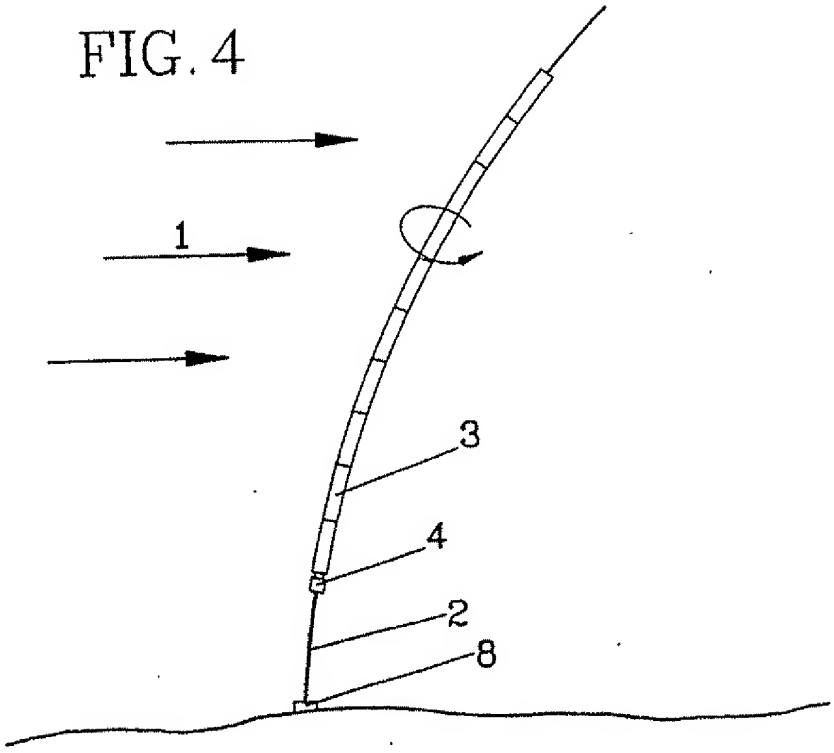


FIG. 5

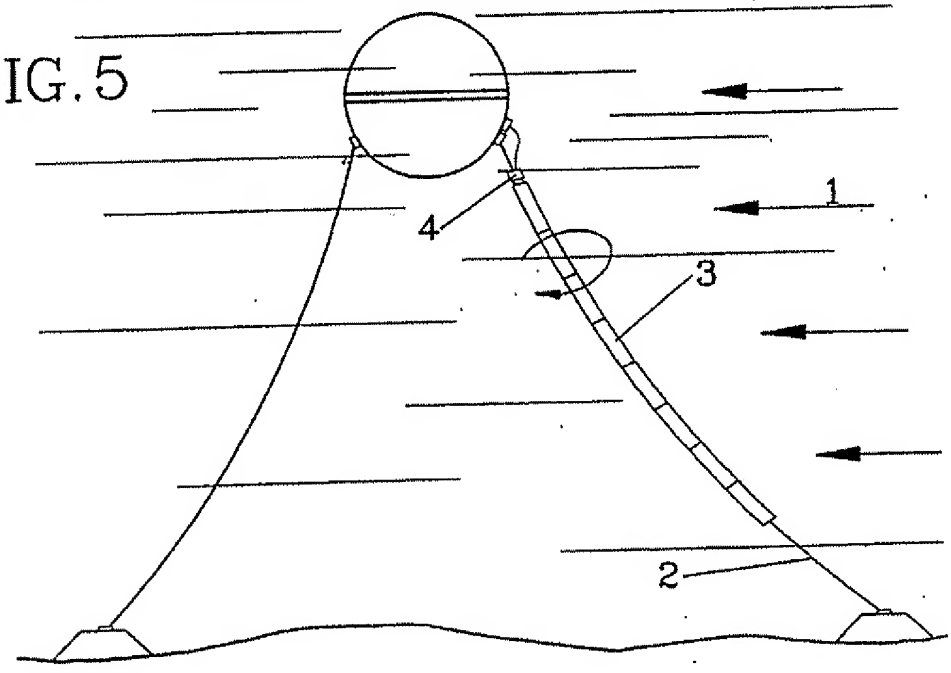


FIG. 6

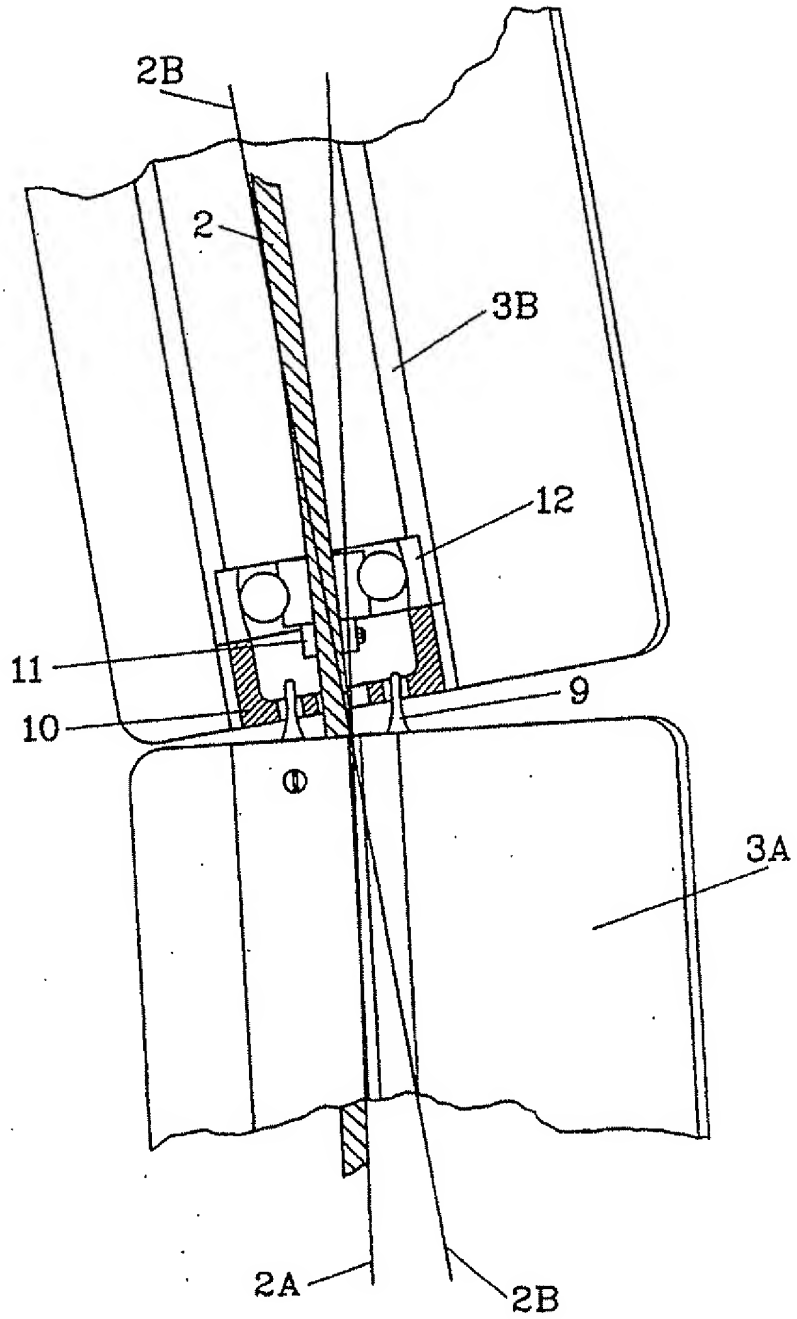


FIG.7

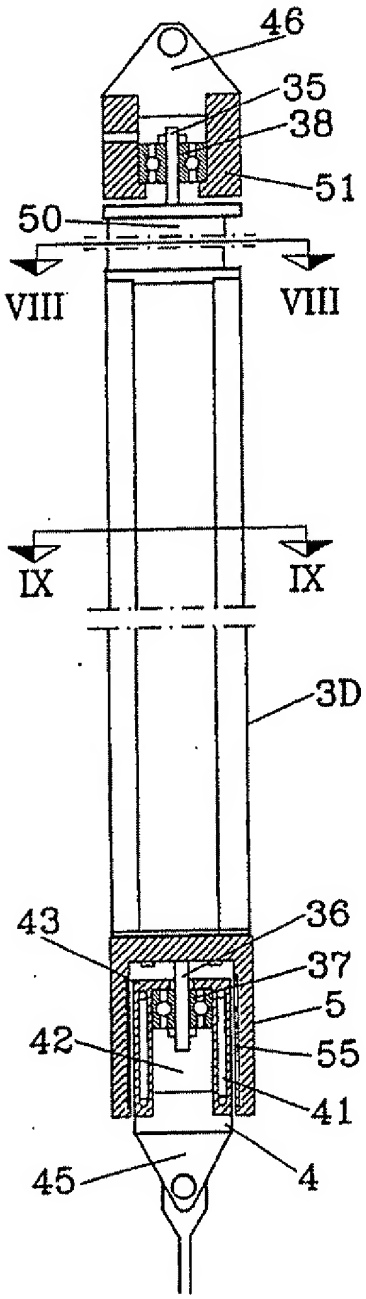


FIG.8

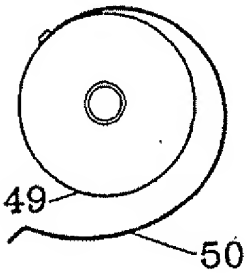


FIG.9

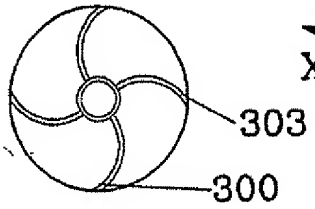


FIG.10

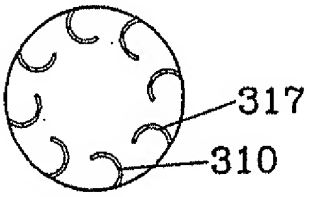


FIG.12

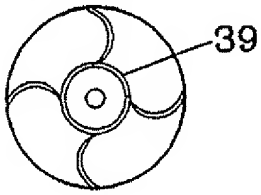


FIG.13

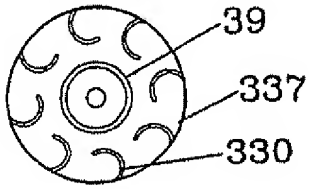


FIG.11

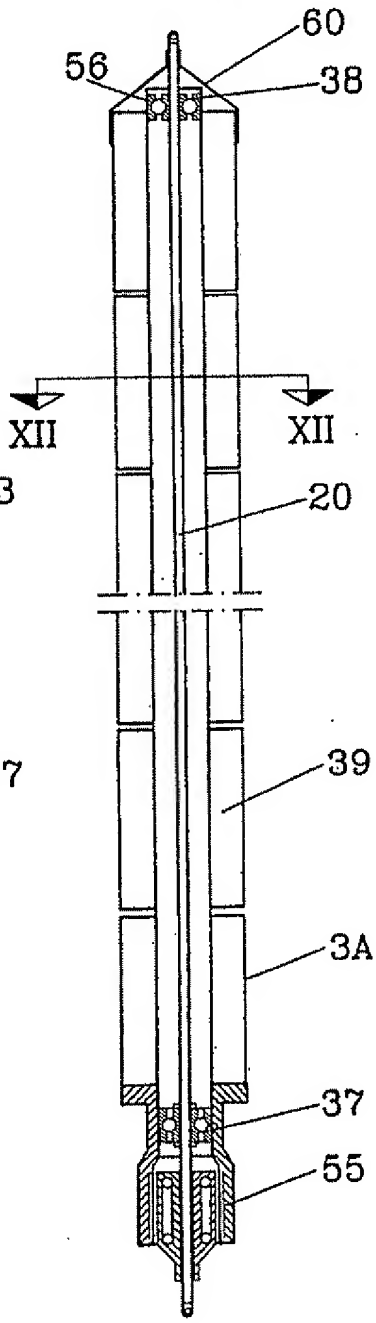
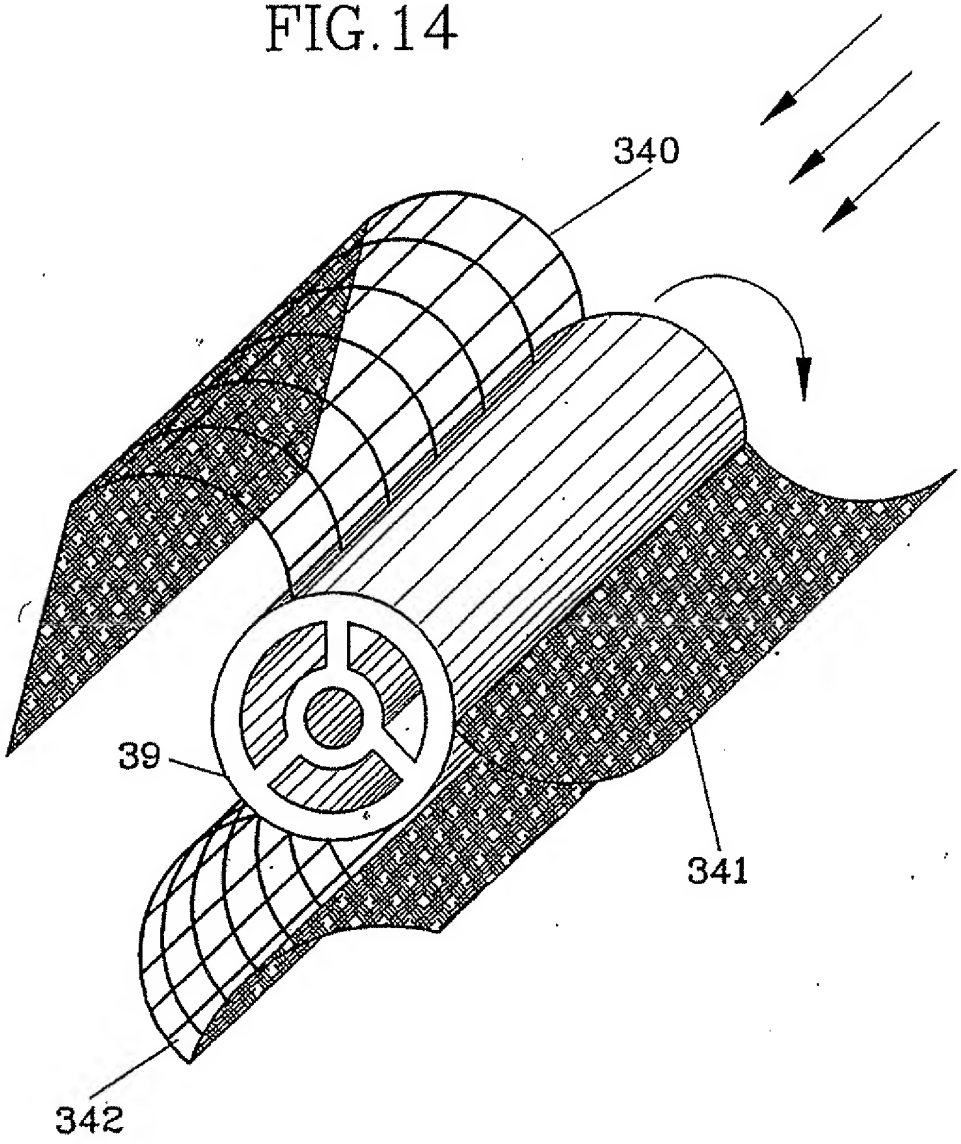


FIG.14



INTERNATIONAL SEARCH REPORT

International Application No PCT/SE 90/00061

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC5: F 01 D 15/10, F 03 B 13/10, F 03 D 3/02

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC5	F 01 D; F 03 D; F 03 B; B 63 J

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

SE,DK,FI,NO classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
X	US, A, 4084102 (FRY ET AL) 11 April 1978, see the whole document --	1-3
A	FR, A, 2455685 (DEMOURY MARC J.) 28 November 1980, see the whole document --	
A	Patent Abstracts of Japan, Vol 8, No 197, M324, abstract of JP 59- 87280, publ 1984-05-19 (HITACHI SEISAKUSHO K.K.) --	

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
3rd April 1990	1990 -04- 11
International Searching Authority	**Signature of Authorized Officer**
SWEDISH PATENT OFFICE	P-O Warnbo

Form PCT/ISA/210 (second sheet) (January 1985)

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. PCT/SE 90/00061

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 4084102	78-04-11	US-A- 4165468	79-08-21
FR-A- 2455685	80-11-28	NONE	